FILE COPY

PROPOSED FY 1966 PROGRAM
STATE OF OHIO
WATER RESOURCES RESEARCH INSTITUTE

to

Director, Office of Water Resources Research
The United States Department of Interior

Submitted by:

Water Resources Center
The Ohio State University

May 15,1965

THE OHIO STATE UNIVERSITY
ENGINEERING EXPERIMENT STATION
WATER RESOURCES CENTER
1791 NEIL AVENUE
COLUMBUS, OHIO 43210

May 15, 1965

293-6108

Dr. Roland R. Renne, Director
Office of Water Resources Research
The U.S. Department of Interior
Washington, D.C. 20240

Dear Dr. Renne:

The Water Resources Center at The Ohio State University hereby respectfully submits its request for an allotment of $87,500.00 for the fiscal year 1965-66 to continue operations of the Water Resources Research facility serving the State of Ohio. It is intended that the allotment will be utilized to provide assistance in conducting basic and applied water resources research as designated in Public Law 88-379.

The accompanying request outlines the work program for the projects which will be continued for the next fiscal year and also describes one new project which is being requested in the area of economics relating to the overall acid mine drainage problem. The request evidences the various requirements for program participation in accordance with part 502 of the Office of Water Resources Notice of Proposed Rules and Regulations as published in the Federal Register, Volume 29, number 212, October 29, 1964.

Very truly yours,

George P. Hanna, Jr.

George P. Hanna, Jr.
Director, Water Resources Center

GPH/jm

PROPOSED FY 1966 PROGRAM
STATE OF OHIO
WATER RESOURCES RESEARCH INSTITUTE

TO

Director, Office of Water Resources Research
The United States Department of Interior

Submitted by

George P. Hanna, Jr., Director
Water Resources Center
The Ohio State University

May 15, 1965

REQUEST FOR FISCAL YEAR 1965-66 ALLOTMENT
For
WATER RESOURCES RESEARCH
at
THE OHIO STATE UNIVERSITY

to

Director, Office of Water Resources Research
The United States Department of the Interior

REQUESTING INSTITUTION

The Water Resources Center of The Ohio State University hereby requests an allotment of $87,500.00 for the fiscal year 1965-66 to provide assistance in conducting basic and applied water resources research as designated under Public Law 88-379 and in accordance with Part 502 of the Office of Water Resources Research, Notice of Proposed Rules and Regulations as published in the Federal Register, Volume 29, Number 212, October 29, 1964.

RESPONSIBILITY FOR ACCOUNTING AND REPORTING

Since the initial allotment request, Mr. Ernest W. Leggett, Assistant Treasurer, The Ohio State University, has been appointed by the University President replacing Mr. Clinton V. Oster, as the officer to receive an account for all funds paid under the Act (Public Law 88-379) and to make annual reports to the Secretary of the Interior together with a detailed statement of the amount received under any provision of the Act during the proceeding fiscal year and of its disbursement or schedules prescribed by the Secretary. A copy of Mr. Leggett's appointment was included with the first voucher submitted to the Department.

PLAN OF PROGRAM OPERATION

There is no change in the administrative organization of the Water Resources Center from the organization plan as was indicated in the initial allotment proposal dated November 30, 1964. The overall aims and goals also remain the same, and the four projects initiated under the first allotment are all continuing during the next fiscal year.

A new project included in this proposal involves an analysis of the economics of alternative plans of considering the acid mine drainage problem, including the extent to which abatement would be in the economic interests of the region. This proposed project fits in with the more technical programs currently being pursued in this area, and works toward the major goal of determining the optimum utilization of water resources consistent with both sociological and economic developments. The continued concentration of effort in the acid mine drainage area, variously described as one of our major water resource problems in Ohio, will, we are confident, establish basic technical,economic, and sociological criteria suitable for a more sound appraisal of the entire problem. The proposed economic study is described more fully in a following section.

CONTINUING PROGRAMS

The four programs discussed as follows will be continued during the coming year. A statement of emphasis of work and a budget is included for each of the projects. A progress report will be submitted on each project when due.

WRC-101 Development of a "Natural" Laboratory for the Study of Acid Mine Drainage

It is anticipated that the geologic and hydrologic characterization of the test

mine currently being activated, and of the immediate surrounding area will require approximately nine months of work. During this time the chemical and mineralogical characterization and aerial extent of exposed minerals within the mine will be determined and the mine will be accurately mapped. The hydraulic characteristics of the strata surrounding the mine will be determined, and an attempt will be made to establish a functional relationship between the water table elevation in the hillside surrounding the mine, the groundwater temperature, the water level within the mine, and the amount of groundwater flowing into the mine. The amount and locations of leakage from the sealed mine through the walls and floor will also be related to the above variables. In addition to the hydraulic characteristics of the mine, the permeability of the mine to gas will be determined under various degrees of flooding.

Following the characterization of the mine, it will be resealed and an investigation will begin of the chemical reactions occurring under controlled conditions. The quantity and quality of water entering and leaving the mine will be monitored and the atmosphere in the mine itself will be artificially controlled. The remaining three months of the fiscal year will be employed in the initiation of this phase of the investigation.

Current activities are involved in preparing the sealed mine and the mine's site for the studies to be pursued. This includes draining of the mine, physical checking of the seal and installing equipment in order to be able to sample both water and atmosphere from various portions of the sealed mine. It also includes the boring of various test holes around the periphera of the sealed mine in order

to interupt the water surface level to provide a means for measurement and correlation of the flow of water into and out of the mine through the groundwater table.

One of the first studies to be started after the mine is resealed will be the rate of acid production at different strata levels in the mine. This will be attempted as was described in the previous initial request. The specific proposal in terms of the initial effort and the ultimate goals remain as previously indicated.

The following budget is submitted for July 1, 1965 through June 30, 1966.

Personnel-Salaries and Wages		
Professional personnel (1/2 man yr.)	$ 6,500	
Graduate student (1/2 man yr.)	3,000	
Total for personnel		$ 9,500
Supplies and Services		
Lab supplies, computor services & other services necessary on project		1,900
Equipment		
Field type pH meter for running field experiments.	$ 350	
Vacuum pump (for producing vacuum on system).	150	
Continuous recording equipment (for installation on observation wells and mine.	1,250	
Total for equipment		$ 1,750
Travel Expenses		
Travel to mine site for study, observation, and sample collections (approximately 2 trips per week).	$ 1,100	
Travel to scientific meetings (1 man).	150	
Total for travel		$ 1,250
Report Preparation		100
Total budget		$14,500

WRC-102 A Study of the Microbial Flora of Acid Waters

Progress to date indicates that several heterotrophic species of bacteria as well as autotrophic forms are present in waters having a pH of less than 3.8. In addition to the bacteria we have isolated several different molds and green algae, all of which are present in relatively high numbers.

We are presently attempting to quantitize the numbers of each type of microorganism in the waters and to identify the organism with respect to species and biochemical activity. It is anticipated that a considerable amount of time will be spent on this aspect during the summer of 1965.

As the work progresses through the next fiscal year we expect to continue our survey of acid waters in an attempt to draw generalizations with respect to determine the influence of mine acid on microbial ecology. In order to make comparisons and establish a control system we will examine certain non-acid waters in the same watershed. We will also examine waters which are decreasing in acidity because of dilution, neutralization etc., in order to determine how microorganisms might become re-established in streams that had a history of acid pollution.

Time will also be devoted to chemical characterization of the organic content of acid waters, since this must be the organic material which supports growth of the heterotraphic forms we are isolating.

The anticipated budget for the year 1965-66 will be the same as for the previous year. In this regard our efforts will be as indicated in the original proposal. That is, our manpower effort will be spread over the calendar year in a more uniform manner and less intensified than during the present year.

The budget is indicated as follows:

Personnel-Salaries and Wages		
Professional personnel (1/2 man yr.)	$ 7,770	
Graduate students or other technical personnel (1 man yr.)	6,475	
Hourly assistants	1,900	
Total for personnel		$ 16,145
Equipment		
Dual channel recorder (required for hookup with gas chromatograph)		1,700
Supplies and Services		
Reagents, chemicals, glassware, isotopes, growth media, and other expendibles		2,000
Travel		
For field investigations	$ 400	
For attendance at scientific meetings	700	
Total for travel		$ 1,100
Report Preparation		200
Total budget		$ 21,145

WRC-103 A Biological Survey of Acid Mine Waters

The primary long range objective of this project is the development and application of a method for the rapid detection of pollution levels inimical to aquatic life. The initial work is to be concerned with a recognized pollution problem, acid coal mine drainage, and further work will extend to a threatened pollution problem, brine seepage, from oil well operations. Raccoon Creek and tributary waters in the southern part of Ohio, and the upper Olentangy and tributaries in Central Ohio have been selected as the locales for the initial studies.

The basic premise upon which the study is based is that while conventional physical and chemical measurements reflect pollution conditions at a given point in time, the biological organisms present are a measure of pollution conditions extending over a period of time, at least equal to their life span. In the initial phases of the study, intensive field collection of biological organisms in the selected streams will be made. Experimental sampling will be conducted to determine intensity and frequency of collecting necessary to obtain statistically significant quantitative and qualitative measurements. Phytoplankton, zooplankton, invertebrate and vertebrate components of the flora and fauna of the stream will be collected and identified. Concurrent measurement of physical, chemical, and observable indices of pollution will be made for purposes of establishing correlations between biological population and pollution conditions.

A general biological reconnaissance of stream conditions will be conducted to determine the range of conditions present, and to localize an area for intensive

study representative of the problem being investigated. This phase of the work is already underway. Equipment and supplies are being acquired, field crews are being assembled and trained for the intensive work. Advanced undergraduate and graduate students are being employed to do field work under the direction of an experienced, professionally trained aquatic biologist. It is anticipated that six assistants will be employed for field work on a full time basis during the open months of the year, and on a 'when needed' basis for periodic collecting during the remainder of the year. Correlations will be made by the project director as the study progresses. Modifications of procedures will be made in accordance with promising leads which develop as the study progresses.

The following budget is submitted for July 1, 1965 through June 30, 1966.

Personnel-Salaries and Wages		
Professional personnel(1 month full time, 9 months 20 percent of time).	$ 2,645	
Graduate assistant(1 month at $ 450).	450	
Research assistants(estimated wages).		
Summer 4 persons at $ 2.00/hr.		
2 persons at $ 1.50/hr.	4,445	
Total personnel		$ 7,540
Travel		
9000 miles at $ .09/mile	$ 810	
20 overnight trips at $ 21.00/trip	420	
Total for travel		$ 1,230
Supplies and Services		
Replacement of expendible supplies (chemicals, glassware, nets, boots, etc.)		1,280
Report Preparation		200
Total budget		$ 10,250

WRC-104 A Study of Groundwater Contamination due to Saline Waste Water Disposal in the Morrow County Oil Fields

The main objectives of the problem and the methods to be pursued are indicated in Requests for Initial Allotment to Establish a Water Resources Research Institute for the State of Ohio, dated November 30, 1964.

The work planned for the 1965-66 fiscal year may be summarized as follows: During the summer of 1965, a network of shallow observation wells will be installed for the purpose of obtaining a continuous aerial record of salinity variations within the groundwater system in the water table aquafer. Simultaneously, information will be collected on the geologic and hydrologic conditions affecting the movement of groundwater and its relationship to the surface water systems. Data will also be collected on the quantities of saline waste which has been disposed of in the areas of interest, as well as various means by which disposal has been carried out. As data on water quality at observation well locations is collected, additional observation wells will be installed where more information is considered necessary.

During the last eight months of fiscal year 1966, emphasis will be on the collection of data from the well network. This will be used to begin calculations on the present and future behavior of the saline wastes which has infiltrated into the groundwater system in this area. Dr. J.H. Lehr will continue as the Principal Investigator on this project.

The budget for the fiscal year 1965-66 is included as follows:

Personnel-Salaries and Wages		
Professonal personnel, hydrologist-summer salary at 2/9 annual salary.	$ 2,154	
Three graduate assistants at $1280 each/yr for 3 periods.	3,840	
Total personnel		$ 5,994
Supplies and Services		
Hydraulic model supplies(plexiglas, building materials, tubing, expendible pumps, etc.).	1,500	
Observation well service and maintenance	1,306	
Total supplies & services		$ 2,806
Travel Expenses		
Field expenses for graduate student and hydrologist(80 man days in field at $16.00/day.	$ 1,280	
Mileage-6600 miles at $ .09/mile	594	
Total Travel expenses		$ 1,874
Report Preparation		200
Total budget		$10,874

ADDITIONAL PROPOSED PROJECT FOR FISCAL YEAR 1965-66

The following project as described has been selected by the Water Resources Center Advisory Committee as the recommended one for support during the coming fiscal year. This project has been selected for the following reasons:

1. The proposal provides a means of economically reviewing the acid mine drainage problem in terms of the overall problems of the area and the economic development of region as a whole.

2. The study will be closely tied in with the other programs which are currently being pursued in the acid mine drainage area.

3. A search of the literature has revealed no projects of this nature currently being pursued.

4. The research will pave the way for an expansion of the study of pollution control and water reuse systems in southeastern Ohio.

WRC-105 Alternative Economic Responses to the Acid Mine Drainage Problem in Southeastern Ohio

PURPOSE

The purpose of the proposed research is to analyze the economics of alternative means of dealing with acid mine drainage and the extent to which abatement would be in the economic interests of the region. The study would take account of indirect (secondary and higher order) effects on the economy of the region as a result of adjustments implied for 1) coal mining; 2) economic activities damaged by acid mine drainage; and 3) economic development of the region as a whole under other (Appalachia) programs. The intent would be to discover economically efficient alternatives rather than a unique optimum solution.

The research would pave the way for a wider study of pollution control and water reuse systems in Southeastern Ohio, again, taking account of economic effects on 1) waste dischargers; 2) those damaged; and 3) economic development of the region.

RESEARCH DESIGN

Two major classes of data are required for the project: 1) direct cost and benefit estimates of alternative methods of reducing acid mine drainage; and 2) indirect effects of such costs and benefits on the economic activities of the region. For purposes of the present discussion, the term "benefits" refers to cost savings resulting from alternative abatement policies.

Data of the first type will be computed from technological and cost information already available in the library of The Ohio State University Water Resources

Center, The Ohio State University Natural Resources Institute and a number of state agencies located in Columbus. Such data will include costs of acid control and their effects on the cost of coal production in the area. The data on gains from control will include effects on municipal waste treatment, on industrial uses of water in the region and on agricultural uses. Methodological problems are discussed in reference 3. Gains will also be considered from activities that can become important in the region, such as recreation, but this part of the analysis must also take account of other associated costs such as land acquisition (where necessary) and the preparation of recreation sites. A good deal of progress has been made in the methodology for analyzing the value of recreation (reference 1) and in cataloguing the economic resources of the region affected by acid mine drainage (reference 2).

The indirect (secondary and higher order) economic effects on the region will be investigated by the use of an input-output table to be constructed from data from the U.S. Bureau of the Census, Industry Division. The table will be used to determine the effects of changes in the various outputs of the region (for example, coal or recreation) on all other economic activities in the region. The principal investigator is currently conducting research involving the use of an input-output table based on Bureau of Census data for the projection of regional growth. (reference 4).

The present project is designed for a two year research program covering academic years 1965-66 and 1966-67. Emphasis during the first year will be on direct costs and cost savings of particular industries, municipalities, and

other economic units. In addition, work will be started on indirect effects before the end of the first year. In the second year, principal attention will be given to indirect effects. The input-output analysis will be set up in such a way that the economic impact of related federal programs, such as federal expenditures for sealing abandoned mines, can be taken into account.

PRINCIPAL INVESTIGATOR

Dr. Richard A. Tybout
Department of Economics
The Ohio State University

Half time for academic years 1965-66 and 1966-67.

A biography of the principal investigator is included in Appendix C, "Request for Initial Allotment to Establish a Water Resources Research Institute for the State of Ohio", submitted by Water Resources Center, The Ohio State University, to Director, Office of Water Resources Research, The United States Department of Interior, November 30, 1964.

FUNDS REQUESTED FOR 1965-66

Principal investigator (1/2 time, 9 months)	$ 0 *	
One research assistant (1/2 time, 9 months)	3,078	
Data from U.S. Bureau of the Census	9,500	
Travel, clerical, telephone	422	
Total		$ 13,000

*The Ohio State University Department of Economics is contributing $ 7,500 to cover the salary of the principal investigator on a half-time basis for nine months.

FUNDS REQUESTED FOR 1966-67

Principal investigator (1/2 time, 9 months)	$ 7,500	
One research assistant (1/2 time, 9 months)	3,078	
Programming assistance	5,000	
Computer time	10,000	
Travel, clerical, telephone	422	
Total		$ 26,000

PLANS BEYOND 1966-67

As pointed out in the statement of purpose above, the successful completion of this project will open the way for a broader investigation of water reuse systems in Southeastern Ohio. Much of the regional economic information acquired for the present project would also be needed for the subsequent broader study, and for this reason there would be advantages in conducting both.

REFERENCES

Robert K. Davis, The Value of Outdoor Recreation: An Economic Study of the Maine Woods (Ph.D. Dissertation, Harvard University, 1963).

Sten Erik Drugge, Economic Inventory and Value Added Estimates of the Natural Resources of a Watershed Region Located in the Appalachian Highland Area of Ohio (Ph.D. Dissertation, Ohio State University, 1964).

Allen V. Kneese, The Economics of Regional Water Quality Management (Johns Hopkins Press, 1964).

Richard A. Tybout, "Interindustry Structure of Columbus Metropolitan Area", Columbus Economic Base Study (forthcoming).

FINANCIAL PLAN

A summary of the proposed total program budget for the next fiscal year (July 1, 1965 through June 30, 1966) is included as follows:

1. Program Administration

Personnel-Salaries			
Program director (75 percent of time)	$ 9,854		
Secretary (full time)	3,252		
Total salaries		$ 13,106	
Supplies and Services			
Office supplies, reproductions, etc.	560		
Telephone and mailings	750		
Repair, maintenance, etc.	565		
Total supplies & services		1,875	
Travel			
Travel for coordination of work throughout the area & to attend meetings, seminars, etc.		850	
Seminars and Conferences			
Funds to provide for seminars with federal, state, & county local agencies to coordinate water resource activities; meetings, & conferences with non-governmental groups, concerned with water resources in the state		1,900	
Subtotal			$ 17,731

2. Projects

WRC-101 "Development of a 'Natural' Laboratory for Study of Acid Mine Drainage"	$ 14,500	
WRC-102 "A Study of the Microbial Flora of Acid Waters"	21,145	
WRC-103 "A Biological Survey of Acid Mine Waters"	10,250	
WRC-104 "A Study of Groundwater Contamination Due to Saline Waste Water Disposal in the Morrow County Oil Fields"	10,874	
WRC-105 "Alternative Economic Responses to the Acid Mine Drainage Problem in Southeastern Ohio"	13,000	
Subtotal		$ 69,769
Total program budget		$ 87,500

EXPENDITURE PLAN

The following schedule indicates the proposed rate of program activity for the period of July 1, 1965 through June 30, 1966 and further indicates times at which there will be a need for the budget amount as specified.

July 1	$ 25,000
October 1	23,000
January 1	18,000
March 1	21,500
Total	$ 87,500

NOTICE OF RESEARCH PROJECT

A "Notice of Research Project" for the newly proposed project "Alternative Economic Responses to the Acid Mine Drainage Problem in Southeastern Ohio" is included in the report. Copies of these notices will be furnished to the Smithsonian Institution Science Information Exchange upon project approval.

NOTICE OF RESEARCH PROJECT
SCIENCE INFORMATION EXCHANGE
SMITHSONIAN INSTITUTION

SIE NO.
AGENC NO.

NOT FOR PUBLICATION OR PUBLICATION REFERENCE

SUPPORTING AGENCY: OFFICE OF WATER RESOURCES RESEARCH
DEPARTMENT OF THE INTERIOR

TITLE OF PROJECT:

Alternative Economic Responses to the Acid Mine Drainage Problem in Southeastern Ohio

Give names, departments, and official titles of PRINCIPAL INVESTIGATORS and ALL OTHER PROFESSIONAL PERSONNEL engaged on the project.

Dr. Richard A. Tybout, Professor, Department of Economics

NAME AND ADDRESS OF INSTITUTION:

The Ohio State University, Columbus, Ohio

SUMMARY OF PROPOSED WORK – (200 words or less.) – In the Science Information Exchange summaries of work in progress are exchanged with government and private agencies supporting research, and are forwarded to investigators who request such information. Your summary is to be used for these purposes.

The research seeks to determine the economic merits of alternative means of dealing with acid mine drainage and the extent to which abatement would be in the economic interests of the region. Direct costs implied for coal mining and cost savings for other economic activities (including recreation) will be determined for selected programs of pollution control. Indirect consequences of these costs and cost savings will be determined for the region as a whole using an economic input-output matrix based on data to be obtained from the U.S. Bureau of the Census, Industry Division. The object will be to discover economically efficient alternatives rather than a unique optimum solution. The project will begin in October, 1965 and extend for a period of two years.

SIGNATURE OF PRINCIPAL INVESTIGATOR Richard A. Tybout

PROFESSIONAL SCHOOL (medical, graduate, etc.) College of Commerce